

DIAGNOSTIC AND PSYCHOSOCIAL PREDICTORS OF EXCESSIVE EXERCISE  
USE AMONG ADOLESCENTS WITH SYMPTOMS OF ANOREXIA OR BULIMIA

by

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## ABSTRACT

DARCY WALLUS ALEXANDER. Diagnostic and psychosocial predictors of excessive exercise use among adolescents with symptoms of anorexia or bulimia. (Under the direction of DR. SHARON G. PORTWOOD)

This study examined the ability of several diagnostic and psychological indicators to predict the use of excessive exercise as a weight loss or compensatory behavior for adolescent patients with symptoms of anorexia nervosa (AN) or bulimia nervosa (BN) in a community outpatient sample. It was hypothesized that the additional assessment of eating attitudes, preoccupation with dieting and oral control, bulimia and food preoccupation, body dissatisfaction, drive for thinness, and overall psychological functioning would enhance the predictability of excessive exercise use. Participants were male and female adolescent outpatients from the Levine Children's Hospital Center for Disordered Eating in Charlotte, North Carolina who met diagnostic criteria for AN, BN, or eating disorder – not otherwise specified. Participants completed a demographics questionnaire, the Obligatory Exercise Questionnaire, the Eating Attitudes Test-26, and the Eating Disorders Inventory-3. Information related to patients' body mass index, eating disorder diagnosis, and global assessment of functioning was also collected. Results of this study revealed that overall eating attitudes scores alone are sufficient in predicting excessive exercise use. The additional assessment of dieting and oral control, bulimia preoccupation, body dissatisfaction, drive for thinness, and overall psychological functioning did not enhance the predictability of excessive exercise use. The difficulty of conducting research with psychological patients within a medical institution, study limitations, and future directions are discussed.

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## LIST OF ABBREVIATIONS

AN	anorexia nervosa
APA	American Psychiatric Association
BN	bulimia nervosa
CDE	Center for Disordered Eating
DSM	Diagnostic and Statistical Manual of Mental Disorders
ED-NOS	Eating Disorder – Not Otherwise Specified



## CHAPTER 1: INTRODUCTION

Results of the 2001 – 2003 National Comorbidity Survey Replication reveal lifetime prevalence rates for anorexia nervosa (AN) and bulimia nervosa (BN) of 0.9% and 1.5% for women, and 0.3% and 0.5% for men, respectively (Hudson, Hiripi, Pope, & Kessler, 2007). It has also been estimated that between 0.04% and 3.0% of young girls and between 0 and 0.2% of young boys experience symptoms of AN, BN, or binge-eating disorder (Ackard, Fulkerson, & Neumark-Sztainer, 2007; Becker, Grinspoon, Klibanski, & Herzog, 1999). Furthermore, evidence is increasingly supportive of the opinion that diagnostic criteria for the eating disorders as outlined in the American Psychiatric Association's Diagnostic and Statistical Manual for Mental Disorders are sufficiently strict that many patients with disordered eating-related behavior severe enough to warrant treatment and to cause emotional distress often fail to meet full diagnostic criteria (Ackard et al., 2007; DeAngelis, 2009; Fisher, Golden, Katzman, Kreipe, Rees, Schebendach, et al., 1995). Therefore, prevalence rates are likely higher than previously estimated. Although eating disorders are rare in general, their effects are often exacerbated due to the seriousness of the symptoms (e.g., maintaining extremely low body weight in AN), the associated physical and psychological comorbidities, and the failure of many individuals to seek treatment (Hudson et al., 2007; Sullivan, 1995).

One associated feature of both AN and BN is the use of excessive exercise as a weight loss or compensatory behavior. Excessive exercise has been linked to a

heightened risk of psychological and physical sequelae, as well as poorer treatment outcomes, including longer treatment stays and quicker time to relapse. Self-regulation theory suggests that patients might engage in excessive exercise as a means of controlling weight and managing the multiple symptoms and comorbid psychological disorders that accompany eating disorders. Unfortunately, however, the majority of research examining excessive exercise use in eating disorder patients has been conducted primarily using adult samples, while research assessing this construct in adolescent eating disorder samples is sparse. The purpose of the current study is to examine the diagnostic and psychosocial predictors of excessive exercise use among adolescent outpatients with symptoms of AN and BN. In effort to assist clinicians, the proposed study will also seek to determine whether inclusion of a set of measures often associated with eating disorder symptomatology enhances the diagnostic predictability of excessive exercise use, above and beyond the measures and results of the clinical interview typically included in a standard clinical eating disorder assessment.

### Public Health Implications

Eating disorders in adolescence remain a serious public health concern, with evidence suggesting growing incidence rates, particularly of BN, with each new birth cohort (Hudson et al., 2007). Eating disorders often cause serious and sometimes irreversible damage to a variety of biological pathways and functions; they have been linked to reduced metabolic activity, hypothalamic temperature dysregulation, increased activation of the hypothalamic-pituitary-adrenal axis, poor cardiovascular reactivity, a disturbed gastrointestinal system, skeletal and dermatologic problems, and increased risk of anemia, osteopenia, and other vitamin and mineral deficiencies secondary to deficits in

nutritional intake. Adolescent patients are at particular risk for growth disturbances, delayed or interrupted onset of puberty, and a reduction in bone-mass development, leaving them at risk for osteoporosis later in life (Fisher et al., 1995).

In moderate doses, low impact exercise has been linked to reduced anxiety via the beneficial effects in cardiovascular reactivity in eating disorder patients (Fisher et al., 1995). However, because of the potential treatment implications, exercise of an excessive nature is viewed as a dangerous symptom. In the presence of other eating disorder symptoms, excessive exercise has been linked to enhanced levels of fatigue and energy deficiencies, heightened risk for amenorrhea, and exercise-induced injuries, including stress fractures (Fisher et al., 1995). A review of hospital records over a three-year span demonstrated that AN, BN, and eating disorder not otherwise specified (ED-NOS) patients' engagement in excessive exercise was associated with significantly longer inpatient hospital stays compared to patients who engaged in more reasonable amounts of exercise or no exercise at all (Solenberger, 2001). Additional studies have shown that excessive exercise in eating disorder patients is associated with dieting initiation earlier in life, poorer treatment outcomes and longer required treatment overall, a shorter time to relapse, and a lower current and lifetime body mass index (Brewerton, Stelfox, Hibbs, Hodges, & Cochrane, 1995; Strober, Freeman, & Morrell, 1997; Shroff, Reba, Thornton, Tozzi, Klump, Berrettini, et al., 2006).

#### Excessive Exercise Defined

The American Psychiatric Association's (APA) Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) lists "excessive exercise" as one behavior often adopted by patients with AN or BN for weight loss or compensatory purposes (APA, 2000).

Despite continued debate in the literature on how best to operationalize this construct, for diagnostic purposes, excessive exercise is generally defined as exercise that “significantly interferes with important activities, ... occurs at inappropriate times or in inappropriate settings, or ... continues despite injury or other medical complications” (APA, 2000, p. 590). While excessive exercise is neither necessary nor sufficient for an eating disorder diagnosis, it is most often seen as a primary or secondary method of weight loss in patients meeting diagnostic criteria for AN of the restricting type, or as a compensatory behavior used after an episode of bingeing in patients meeting diagnostic criteria for BN of the non-purging type.

Attempts in the literature to operationalize excessive exercise have yielded standards that support the criteria introduced by the DSM-IV. Adkins and Keel (2005) conducted a literature review that yielded 31 different words or expressions describing unhealthy levels of exercise. The authors described each term as reflecting either a quantitative or a qualitative dimension of exercise behavior. Specifically, they noted that each term used in the literature described an unhealthy level of exercise with respect to either (1) the frequency, intensity, and/or duration of the activity (i.e., excessive in quantity of exercise), or (2) the nature by which the activity is either scheduled, held to a higher priority over other important activities, or the subsequent feelings of guilt and/or anxiety when the exercise regimen is disrupted (i.e., excessive in quality of exercise, or compulsive). The researchers conducted a study comparing the ability of quantitative versus qualitative characteristics of exercise to predict clinical levels of disordered eating in a sample of 265 male and female college undergraduates. Results revealed that a compulsion to exercise was significantly more predictive of eating disorder pathology

than was the quantitative dimension of exercise, which negatively predicted eating disorder symptomatology (Adkins & Keel, 2005). Similar results were obtained in studies examining the role of exercise as a predictor of eating disorder symptomatology in a community sample of Australian women ages 18 to 42 (Mond, Hay, Rodgers, Owen, & Beumont, 2004; Mond, Hay, Rodgers, & Owen, 2006). Mond and colleagues (2004; 2006) demonstrated that, although not always used as a means of weight control, exercise is most appropriately considered to be excessive when it is used as a means of controlling weight or body shape and when missed sessions result in feelings of guilt or anxiety.

#### Correlates of Eating Disorder Symptomatology and Excessive Exercise

As increased attention is being given to excessive exercise within the eating disordered population, prevalence estimates for this specific behavior are beginning to appear in the literature. Current estimates reflect that in adults, anywhere between 37% and 55% of AN, and between 20% and 57% of BN patients endorse engaging in excessive exercise (Shroff et al., 2006). In adolescents, additional estimates suggest that anywhere between 70% and 80% of AN patients endorse engaging in excessive exercise (Davis, Katzman, Kaptein, Kirsh, Brewer, Kalmbach, et al., 1997; Holtkamp, Hebebrand, & Herpertz-Dahlmann, 2004). Estimates of prevalence in adolescent BN patients have not been reported. Although both AN and BN patients endorse this weight control practice, AN patients of the purging type appear to endorse it most often (Davis et al., 1997; Meyer, Taranis, & Touyz, 2008; Shroff et al., 2006).

Within the growing literature base, researchers are beginning to explore excessive exercise as one behavior symptomatic of a multidimensional diagnosis, often characterized by comorbid psychological and social concerns. Researchers have relied on

community and/or convenience samples of otherwise healthy adults, as well as both former and current adult eating disorder patients, to explore the different psychological and social correlates of excessive exercise use. To date, there is little research examining these relationships within adolescents.

Results obtained from community and convenience samples have demonstrated a relationship between a woman's psychological experience and the extent of excessive exercise use, despite the non-clinical nature of the samples being studied. One study examined the relationship between disordered eating, exercise behavior, and general quality of life in Australian women between the ages of 18 and 45 (Mond et al., 2004). Results revealed that both level of eating disorder symptomatology and quality of life were dependent upon a woman's motivations for exercise, such that women who reported feeling obligated to exercise and exercising specifically for weight- or shape-related reasons experienced significantly greater eating disorder symptomatology and significantly poorer quality of life (Mond et al., 2004). Another study of undergraduate women compared ratings of overall eating disorder symptomatology, self-esteem, depression, body image disturbance, thinness attitudes, and overall psychopathology in students who endorsed engaging in fasting plus exercise, fasting alone, or exercise alone as a compensatory behavior, and a control group (LePage, Crowther, Harrington, & Engler, 2008). Results showed that women who reported engaging in vigorous exercise alone experienced significantly greater body image disturbance and restricted eating than did controls, and they were at a significantly increased risk for adopting supplemental compensatory behaviors (e.g., fasting). Women who endorsed engaging in both exercise and fasting experienced even greater psychological disturbance as they were significantly

more likely to report greater thin-ideal internalization, body image disturbance, and self-reported bingeing behavior, and lower self-esteem compared to those who reported using exercise alone as a compensatory behavior.

Not surprisingly, similar findings have been reported in studies examining excessive exercise use in clinical samples. A review of the medical records of 110 female eating disorder patients meeting diagnostic criteria for either AN, BN, or both revealed that patients who endorsed engaging in excessive exercise, defined as exercising for weight control purposes for at least 60 minutes a day, 7 days a week, also experienced significantly more body dissatisfaction and greater emotional disturbance in the face of a two-pound weight gain, and were less likely to abuse laxatives or to vomit for purposes of purging. Significant positive relationships were also found between time spent exercising and level of anxiety and irritability among excessive exercisers. Unfortunately, these researchers did not provide either the participants' age or a list of measures (Brewerton et al., 1995).

Penas-Lledo, Vaz Leal, and Waller (2002) compared levels of overall psychopathology and eating disorder symptomatology in a sample of adult women seeking outpatient care from an eating disorder clinic in Spain. Female patients met diagnostic criteria for either AN of the restrictive or binge/purge type, or BN. Results revealed that all patients who engaged in excessive exercise, defined as exercising five times a week or more for at least one non-stop hour with the goal of burning calories, reported significantly higher rates of depression and significantly poorer rates of general eating attitudes and behaviors compared to patients who did not engage in excessive exercise. Results comparing symptoms between eating disorder diagnostic groups further

revealed significantly higher rates of somatization and anxiety for AN patients alone. The results of this study suggest that excessive exercise may be equally prevalent across the two eating disorder diagnoses, although the severity of comorbid emotional and psychological disturbances is likely greater among AN patients.

Shroff and colleagues (2006) included both current and recovered adult female eating disorder patients in a study examining the psychological correlates of excessive exercise in each of the diagnostic subtypes. Patients met diagnostic criteria for AN of the restrictive type, AN of the purging type, AN of the binge/purge type, BN with only purging behavior, BN with only bingeing behavior, both AN and BN, or ED-NOS. Patients who endorsed some period of excessive exercise during the course of their eating disorder experience reported either exercising in a way that disrupted important daily activities, exercising three hours or more per day and experiencing some type of distress if having to miss an exercise session, frequently exercising during times of the day or at places where considered inappropriate, or exercising when it was physically or medically contraindicated. Results demonstrated that past and current excessive exercisers were significantly more likely to endorse more severe symptoms of anxiety, perfectionism, and obsessions and compulsions than were those who denied engaging in excessive exercise. Excessive exercisers were also more likely to report more severe overall eating disorder symptomatology.

Despite the potential seriousness of excessive exercise use, as well as the evidence for increasing incidence rates of eating disorders in adolescents, few studies examining the relationship between excessive exercise and patients' overall level of eating disorder symptomatology and comorbid psychological and social concerns have



included adolescents. Davis and colleagues (1997) compared rates of excessive exercise use among both adult and adolescent AN and BN outpatients and inpatients. The results of this study demonstrated nearly identical rates of excessive exercise use among both patient groups, suggesting that some of the associated psychological and social influences driving eating disorders actually start in childhood, but may continue unabated into adulthood, potentially impeding treatment efforts. Of additional concern was the finding that adult patients who endorsed engaging in excessive exercise use during adolescence were significantly more likely to continue engaging in this behavior as adults. In a study examining various psychological predictors in a sample of 30 German female adolescent anorexic inpatients, Holtkamp and colleagues (2004) found self-reported food restriction and anxiety to be significant predictors of excessive exercise use, although, as in other studies, obsessive-compulsive tendencies, body image disturbance, slimness ideal, and depression were not.

### Constructs of Interest

The research discussed thus far has highlighted several psychological constructs that have been studied in relation to excessive exercise use within certain disordered eating populations. Each of these constructs (i.e., body dissatisfaction, drive for thinness, depression, anxiety, and overall psychopathology) has also been explored in greater depth within the broader disordered eating literature, emphasizing the need to include such constructs in a study examining the correlates of excessive exercise use as a weight loss or compensatory behavior in a community sample of adolescent eating disorder outpatients. Furthermore, and as represented by the theory of self-regulation, excessive

exercise appears to function as a way to manage individuals' experiences with each of these constructs as they strive to meet individual weight-related goals.

Self-regulation theory. Self-regulation theory suggests that individuals engage in specific self-regulatory behaviors as a means of meeting one or multiple health-related goals (Clark & Zimmerman, 1990). Because the ultimate goal of optimizing health as defined by the broader health community (e.g., maintaining a medically approved weight) is not necessarily applicable, self-regulation theory can be applied to eating disorder patients who engage in a variety of self-destructive health-related behaviors as a means of meeting some preconceived ideas about weight.

Prior research supports inclusion of the theory of self-regulation in the study of both exercise and eating disorders. Macdonald and Palfai (2008) found that, in a group of college undergraduate females, those who sustained regular exercise regimens over time were more likely to engage in self-regulatory behaviors like planning and goal setting. The same women also reported experiencing significantly more negative affect after failing to achieve an exercise-related goal. In a sample of college undergraduate females, Kitsantas, Gilligan, and Kamata (2003) found that those with a diagnosable eating disorder reported engaging in significantly more self-regulatory behaviors compared to a group of individuals considered at-risk and a control group. Results of these studies support the potential maladaptive nature of exercise when used as a weight loss or compensatory behavior in eating disorder patients, as the nature of these disorders prevents patients from setting realistic weight-related goals. Furthermore, previous work has shown that simply setting a weight loss goal is associated with more self-reported negative affect in general (Roncolato & Huon, 1998). It can therefore be expected that

exercise driven by weight loss-related goals likely functions to control the associated negative mood states (Macdonald & Palfai, 2008), including patients' drive for thinness, body dissatisfaction, depression, anxiety, and general psychopathology, each of which has been associated with excessive exercise use in both clinical and non-clinical samples (Brewerton et al., 1995; Holtkamp et al., 2004; LePage et al., 2008; Mond et al., 2004; Penas-Lledo et al., 2002; Shroff et al., 2006).

It is therefore suggested that excessive exercise functions as a self-regulatory behavior in some eating disorder patients as a means of controlling weight and managing some of the more common symptoms and psychological disorders that commonly co-occur. Specifically, patients' negative mood regarding the body and an overall negative psychological experience inspires excessive exercise as a, albeit maladaptive, self-regulatory means of managing weight.

Body dissatisfaction and drive for thinness. Body dissatisfaction and drive for thinness are two constructs often experienced by eating disorder patients and make up two of the subscales captured on the Eating Disorder Inventory-3. A disturbed body image and/or the preoccupation with body weight or shape is so frequently endorsed by both AN and BN patients that it is now included among the diagnostic criteria for both disorders in the current version of the DSM-IV (APA, 2000). Using the Perceived Body Image Scale, Manley, Tonkin, and Hammond (1988) compared body image disturbance between groups of adolescent AN patients, BN patients, and controls. Results revealed significantly higher levels of both cognitive and affective experiences of body image disturbance within the BN patients, with AN patients demonstrating the least affected body image of the three groups. However, on the perceptual measure of body image

disturbance, BN patients and control participants reported similar assessments of actual body size and shape, ratings that were significantly higher than those of the AN patients.

Finding more severe body image disturbance in BN patients compared to AN patients has been replicated in more recent studies as well. Using the Eating Disorders Inventory, Ruuska, Kaltiala-Heino, Rantanen, and Koivisto (2005) found significantly higher levels of body image disturbance in a group of adolescent BN outpatients compared to a group of adolescent AN outpatients. Regression analyses further revealed that body dissatisfaction was best predicted by BN status and overall psychological symptom severity as assessed by the global severity index on the Symptom Checklist-90. Duration of the eating disorder experience was also significantly positively related to overall negative feelings regarding patients' bodies.

Body image disturbance has also been reported in nonclinical samples of women and men. Varnado-Sullivan, Horton, and Savoy (2006) examined the relationship between body image disturbance and eating disorder symptoms in undergraduate men and women. Although men were significantly more satisfied with their bodies, 62% indicated a discrepancy between their current and ideal body size. However, males were equally likely to prefer either a smaller or larger body size. For females, a higher BMI was associated with more severe body image disturbance, and 79% of participants indicated discrepant current and ideal body sizes.

Drive for thinness is a construct often associated with eating disorders and body image disturbance, and it is believed to be particularly relevant for patients who endorse use of excessive exercise as either a weight loss or compensatory behavior (Vansteelandt, Rijmen, Pieters, Probst, & Vanderlinden, 2007). In addition to significant findings related

to body image disturbance, results of the Manley and colleagues (1988) study revealed significantly lower ideal body weights in patients with either AN or BN compared to an otherwise healthy age-matched control group. No significant difference between eating disorder groups was found despite a significantly higher baseline weight and a baseline weight similar to controls in the BN group. In a comparison of predictors across groups of adolescent AN and BN outpatients, Ruuska and colleagues (2005) found that BN status alone, early onset of menarche, and overall psychological symptom severity were the best predictors of drive for thinness. In the Varnado-Sullivan (2006) study, overweight undergraduate males were more likely to indicate a smaller ideal body size compared to their normal or underweight counterparts, whereas females, regardless of weight, indicated a smaller ideal body size overall.

In a study examining the role of drive for thinness in the daily life of female AN and BN inpatients between the ages of 15 and 37, Vansteelandt and colleagues (2007) assessed drive for thinness, emotional state, the urge to be physically active, and actual physical activity levels periodically throughout the day over the span of one week. Results revealed that self-reported feelings of drive for thinness was positively associated with physical activity levels, a relationship that was even more marked in patients with the lowest BMIs, suggesting a pathological component to patients' exercise behaviors when observed in combination with additional eating disorder symptoms.

Depression, anxiety, and overall psychopathology. Eating disorders have also been examined in relation to other psychiatric diagnoses, with particular attention being paid to the associations between eating disorder symptomatology and depression, anxiety, personality disorders, and substance use. Self-esteem has been examined in conjunction

with depressive experiences and disordered eating in clinical samples. For example, adolescents at either a primary care outpatient clinic or a school nurse's office completed measures of disordered eating, self-esteem, and depression at two time points separated by 10 months (Courtney, Gamboz, & Johnson, 2008). Results revealed that poorer self-esteem at baseline was significantly associated with higher ratings of both disordered eating and depression at 10 months. In addition, patients' depression scores partially mediated the relationship between self-esteem and disordered eating, indicating that for some adolescents, it is their vulnerability to depression resulting from low self-esteem that leaves them at greater risk for developing an eating disorder. In another study, a sample of male and female adolescent AN, BN, and ED-NOS (including sub-threshold AN and BN) outpatients were administered measures of disordered eating, self-esteem, and depression upon admission to an eating disorder clinic (Eddy, Celio Doyle, Rienecke Hoste, Herzog, & le Grange, 2008). Overall, AN patients reported healthier levels of both self-esteem and depression compared to BN patients. Interestingly, there were no significant differences on reports of self-esteem or depression between patients meeting full diagnostic criteria and those who were sub-threshold for AN. However, patients meeting full diagnostic criteria for BN reported significantly poorer levels of self-esteem compared to those diagnosed with sub-threshold BN, despite no differences between the two groups on depression scores.

Depression alone as a sole predictor of disordered eating was examined in a study of high school 9<sup>th</sup> through 12<sup>th</sup> graders (Santos, Richards, & Bleckley, 2007). Results revealed that, regardless of sex, self-reported eating disorder symptomatology based on scores from the Eating Attitudes Test was significantly positively associated with

symptoms of depression as reported using the Center for Epidemiological Studies-Depressed Mood Scale. Measures of self-esteem and body dissatisfaction were also included in this study. However, results of a hierarchical regression revealed that eating attitudes remained a significant predictor of depressive symptoms for all students even after controlling for the effects of both self-esteem and body dissatisfaction. Another study examining the relationship between disordered eating, depression, self-esteem, and body dissatisfaction in male and female college undergraduates yielded similar results (Green, Scott, Cross, Liao, Hallengren, Davids, et al., 2009). Researchers found that after controlling for the effects of both self-esteem and body dissatisfaction, symptoms of depression remained a statistically significant predictor of eating disorder symptomatology.

Clinical levels of depression, anxiety, and personality disturbance were examined in relation to eating disorders in a sample of late adolescent and adult female AN, BN, and ED-NOS inpatients and demographically matched controls (Ahren-Moonga, Holmgren, von Knorring, & af Klinteberg, 2008). Results indicated that eating disorder inpatients were significantly more likely to demonstrate clinically elevated scores on measures of anxiety compared to controls, with BN inpatients more likely to self-report the highest levels of anxiety. No significant differences were found between eating disorder subgroups on symptoms of depression; comparisons between eating disorder subgroups and control participants were not made. In addition, of the 38 inpatients recruited for this study, 10 were diagnosed with a personality disorder, including obsessive/compulsive (present only in AN inpatients), phobic (present only in BN inpatients), and borderline personality disorders (present in both AN and BN inpatients).

Hinrichsen, Waller, and van Gerko (2004) assessed two specific experiences of anxiety, including social phobia and agoraphobia, in adult female AN, BN, and ED-NOS patients. These researchers found that while social anxiety was significantly predictive of patients' scores on each of the Eating Disorder Inventory subscales, assessing eating attitudes, eating behaviors, and ego development, agoraphobia was predictive of only those subscales assessing ego development. Comparisons between eating disorder diagnostic groups were not made. These results highlight the need for assessment of anxiety in eating disorder inpatients and outpatients.

Finzi-Dottan and Zubery (2009) examined the relationship between both depression and anxiety and tendencies toward impulsivity and obsessive-compulsiveness in a sample of 169 AN, BN, and ED-NOS outpatients. Results of regression analyses revealed that a diagnosis of BN or ED-NOS with bulimic features, coupled with clinically elevated scores on a measure of body image disturbance, was most predictive of poor impulse control. Conversely, a diagnosis of AN or ED-NOS with anorexic features was predictive of clinically elevated scores on a measure of obsessive-compulsiveness, but only when scores on measures of depression and anxiety were controlled. These findings suggest a clearer relationship between BN and impulsivity compared to the relationship between AN and obsessive-compulsiveness, although both diagnostic subgroups demonstrated high levels of both impulsivity and obsessive-compulsiveness.

A relationship between eating disorder symptomatology and substance use has also been found in the literature. One study examined the relationship between eating attitudes and behaviors and use of both alcohol and illicit drugs in a national sample of Canadian adolescents and adults (Gadalla & Piran, 2007). Results of this study revealed a



significant positive relationship between level of eating disorder symptomatology and risk for alcohol interference and amphetamine use in both women and men. Women with clinically elevated levels of eating disorder symptomatology were at greater risk for alcohol dependence, and dependence and interference from several illicit drugs, including crack/cocaine, amphetamines, ecstasy, hallucinogens, cannabis, or heroine. The number of different drug classes was also significantly positively associated with level of disordered eating attitudes and behaviors in women. Results similar to these were found in an all female sample of college undergraduates (Dunn, Neighbors, Fossos, & Larimer, 2009). However, findings from this study indicate that alcohol and drug use more often precede the development of eating disorder symptomatology, particularly calorie restriction and self-induced vomiting, than vice versa. It was also found that substance use-related consequences were more strongly correlated with the presence of eating disorder symptomatology than was substance use itself.

The high rate of comorbid Axis I diagnoses in eating disorder populations highlights the clinical relevance of assessing additional pathology in a sample of adolescent eating disorder outpatients. For example, out of 101 female adolescent AN inpatients and outpatients, comorbid Axis I diagnoses were present in 73.3% of the sample (Salbach-Andrae, Lenz, Simmendinger, Klinkowski, Lehmkuhl, & Pfeiffer, 2008). In order of prevalence, the most commonly diagnosed comorbid conditions included the mood disorders, the anxiety disorders (not including obsessive-compulsive disorder), obsessive-compulsive disorder, and substance use disorders, present in 60.4%, 25.7%, 16.8%, and 7.9%, respectively. Similar studies have confirmed the importance of screening for additional comorbid Axis I disorders in BN patients as well. Blinder,

Cumella, & Sanathara (2006) found that 97% of a sample of 2,436 inpatients seeking treatment for either AN, BN, or ED-NOS was diagnosed with at least one comorbid Axis I disorder. Similar to Salbach-Andrae and colleagues' (2008) findings in a sample of AN patients, the mood disorders, anxiety disorders, and substance use disorders were the most commonly diagnosed and were present in 94%, 56%, and 22% of patients, respectively. While obsessive/compulsive disorder and schizophrenia were more likely to be diagnosed in AN patients, substance abuse/dependence and post-traumatic stress disorder were more likely to be diagnosed in BN patients.

### Summary

Prior research has established the relationship between the presence of eating disorder symptomatology and disturbances in depression, anxiety, and patients' overall psychological experience. In addition, excessive exercise specifically has been linked to the presence of these psychological constructs, in both clinical and community samples, though with much less generalizable results. Self-regulation theory suggests that eating disorder patients who engage in excessive exercise as a weight loss or compensatory behavior do so as a means of managing the associated negative symptoms and comorbid psychological disturbances. Serious limitations of the research to date examining excessive exercise as a weight loss or compensatory behavior within the disordered eating population include the use of homogenous convenience samples with respect to age, gender, and racial background; the inclusion of both active and recovered patients; a reliance on retrospective reporting of symptoms and behaviors; and a relatively narrow assessment of excessive exercise (Shroff et al., 2006). Importantly, despite the profound risks to this group, a review of the published literature revealed no study examining the

diagnostic and psychological predictors of excessive exercise use using a community sample of active adolescent eating disorder outpatients.

### Study Objectives

This study adds to the existing adolescent eating disorder literature by examining the diagnostic and psychological predictors of excessive exercise use as a weight loss or compensatory behavior for patients with symptoms of AN or BN in a community outpatient sample. This study also adds to discussions on how best to define “excessive exercise.” Public health implications include the potential for enhancing the predictability of excessive exercise use in outpatient clinics, and treatment approaches to address adolescent eating disorders.

### Research Question

The proposed project is exploratory in nature and will build on existing treatment services offered by the Center for Disordered Eating by conducting a more extensive assessment of “excessive exercise,” or exercise use as a weight loss or compensatory behavior, among a sample of adolescent eating disorder outpatients. The primary research question is (1) To what extent does a patient’s eating attitudes and other disordered eating symptomatology, including body image disturbance and drive for thinness, predict use of excessive exercise as a weight loss or compensatory behavior in patients meeting diagnostic criteria for AN, BN, or ED-NOS, above and beyond patients’ eating disorder diagnosis and overall psychological status?

### Hypotheses

After careful consideration of previous research documenting more severe presentations of eating disorder symptomatology in primarily clinical and/or adult

samples who endorse engaging in excessive exercise, as well as research that has linked eating disorders to a variety of clinically relevant psychosocial concerns, it is hypothesized that adolescent patients who engage in excessive exercise will report significantly poorer eating attitudes, overall eating disorder symptomatology, and overall psychological status. It is therefore expected that the additional assessment of eating attitudes, body image disturbance, and drive for thinness will enhance the predictability of excessive exercise use.

## CHAPTER 2: MATERIALS AND METHODS

### Participants

Participants were 4 male and 18 female adolescent outpatients from the Levine Children's Hospital Center for Disordered Eating (CDE) who met diagnostic criteria for AN ( $n=11$ ), BN ( $n=2$ ), or ED-NOS ( $n=9$ ). It was confirmed by the nurse coordinator at the CDE that all ED-NOS diagnoses were sub-clinical presentations of either AN or BN. Participants' mean age was 15.36 ( $SD=2.11$ ). One patient identified his race as African American, while the remainder identified as European American. Roughly 86% of patients reported being in grades 6 through 12, while the remaining 14% were in their freshman or sophomore year in college. The mean BMI for this sample was 17.03 ( $SD=1.73$ ), with a minimum BMI of 13.5 and a maximum BMI of 19.2. Eight patients, or 36%, were considered clinically underweight. At the time of their participation, all but 4 patients had been in treatment for 12 months or less. The remaining 4 patients had been in treatment for 14, 16, 32, and 35 months.

### Design and Procedures

Recruitment and informed consent. Recruitment was open to all patients receiving treatment at the CDE, including both newly admitted patients and patients in the middle of their treatment program. Patients and their parents were told by a clinical staff member about a study seeking to understand the different factors involved in the development and

maintenance of eating disorders in adolescents, and then invited to participate. Patients who agreed to participate were given the appropriate informed consent/assent form by the clinical staff member for completion prior to administration of the study materials. All patients over the age of 18 completed a standard informed consent document. An assent form and the informed consent document were collected from patients 17-years-old or younger and a parent, respectively. Patients were compensated for their time in the form of a \$10 Target gift card.

Data collection. Once patients agreed to participate in the study and signed the appropriate informed consent/assent document, they were given a packet of study materials by a clinical staff member, which they were asked to complete in a private waiting room prior to meeting with the clinic staff. The study packet was comprised of the measures indicated below, and included questions related to patients' demographic information, exercise behaviors, eating attitudes, and eating behaviors. All study materials were able to be completed within 30 minutes.

### Measures

Demographics. Both patients' and participating parents' age, race, gender, and education level were assessed. Information related to household income, relationship status, and family history of eating disorders was also collected from parents. The demographics form is included as Appendix B.

Excessive exercise. The Obligatory Exercise Questionnaire (OEQ; Pasman & Thompson, 1988) is a 20-item self-report measure of obligatory exercise behavior. This scale takes roughly five minutes to complete and includes items related to exercise frequency, exercisers' experience of distress or guilt after missing an exercise session,

and exercising when physically or medically contra-indicated. Factor analysis yielded three separate domains, including the emotional element of exercise, exercise frequency and intensity, and exercise preoccupation (Steffen & Brehm, 1999). Responses are recorded using a four point Likert scale, from 1 = “Never” to 4 = “Always.” Internal consistency has been reported as  $\alpha = 0.96$ , and test-retest reliability after a two-week period was reported as 0.96. Cronbach’s alpha for the current sample is  $\alpha = .93$ . The OEQ is included as Appendix C.

Eating attitudes. The Eating Attitudes Test (EAT-26; Garner, Olmsted, Bohr, & Garfinkel, 1982) is a 26-item self-report inventory of eating attitudes and other eating disorder symptoms. In addition to an overall score, the 26-item scale provides scores on three subscales related to dieting, bulimia and food preoccupation, and oral control. Responses are captured using a 6-point Likert scale ranging from Always to Never; one item is reversed scored. Total scores greater than 20 are considered clinically significant and indicate the need for follow-up assessment of eating disorder symptomatology. The EAT-26 is considered highly reliable and valid, with estimates of internal consistency for the total scale and the dieting, bulimia and food preoccupation, and oral control subscales of  $\alpha = 0.90, 0.90, 0.84$ , and  $0.83$ , respectively. Cronbach’s alpha for the current sample is  $\alpha = .53$ . The EAT-26 is included as Appendix D.

Disordered eating. The Eating Disorders Inventory-3 (EDI; Garner, 2004) is a 91-item self-report measure of eating disorder symptomatology and includes 12 subscales: drive for thinness, bulimia, body dissatisfaction, self-esteem, personal alienation, interpersonal insecurity, interpersonal alienation, interoceptive deficits, emotional dysregulation, perfectionism, asceticism, and maturity fears. The EDI also yields five

psychological composite scores, including ineffectiveness, interpersonal problems, affective problems, over-control, and general psychological maladjustment. Responses are captured using a 5-point Likert scale ranging from Always to Never. The EDI is considered reliable and valid for use with individuals between the ages of 11 and 53. Estimates of internal consistency for each of the subscales for adolescents range from  $\alpha = 0.63$  to  $0.97$ , and test-retest stability coefficients for the entire normative sample after a one to seven day interval range from  $0.86$  to  $0.98$ . Cronbach's alpha for the current sample is  $\alpha = .43$ . Because of copyright restrictions, the EDI is not included as an appendix.

Diagnostic indicators and overall psychological status. In practice, all CDE patients are given an Axis I and Axis V diagnosis, consistent with the multi-axial diagnostic system provided by the Diagnostic and Statistical Manual of Mental Disorders, 4<sup>th</sup> edition (APA, 2000). Information related to eating disorder classification and patients' global assessment of functioning was captured using this process. Information regarding eating disorder diagnosis was available for all participants; however, Axis V diagnoses were available for only 10 participants. All diagnoses were assigned by a licensed clinical psychologist or the medical director of the clinic.



## CHAPTER 3: RESULTS

Before describing the results, it is first necessary to address one of the study's primary limitations. A total of 22 participants were recruited for this study; however, because of data inaccessibility for some patients who were recruited several months and sometimes years after beginning treatment, EDI-3 data were missing for 9 participants. Furthermore, as a result of the CDE's loss of its clinical psychologist, overall psychological functioning as measured using Axis V diagnoses, was missing for 12 participants. As a result, the final hierarchical regression model testing the study's primary hypothesis includes data for only 5 participants. For this reason, the findings of this study must be interpreted with caution. Additional implications of the small sample size are addressed further in the discussion section.

### Regression Assumptions

Initial inspection of the data revealed two possible violations of the assumptions of regression. Residuals were saved from the original proposed regression model and plotted with each predictor variable. For each scatterplot, the Loess line was used to determine fit. As evidenced in Figure 1, the Loess line for the scatterplot of the overall EAT score is not flat and does not lie near the y-axis, suggesting a violation of the model specification. To confirm, a subsequent test of the normality of the residuals was conducted. As predicted, the Normal P-P Plot of Regression Standardized Residuals

(seen in Figure 2) demonstrated marked scatter, suggesting a violation of the assumption of the normality of residuals and a misspecification of the overall regression model.

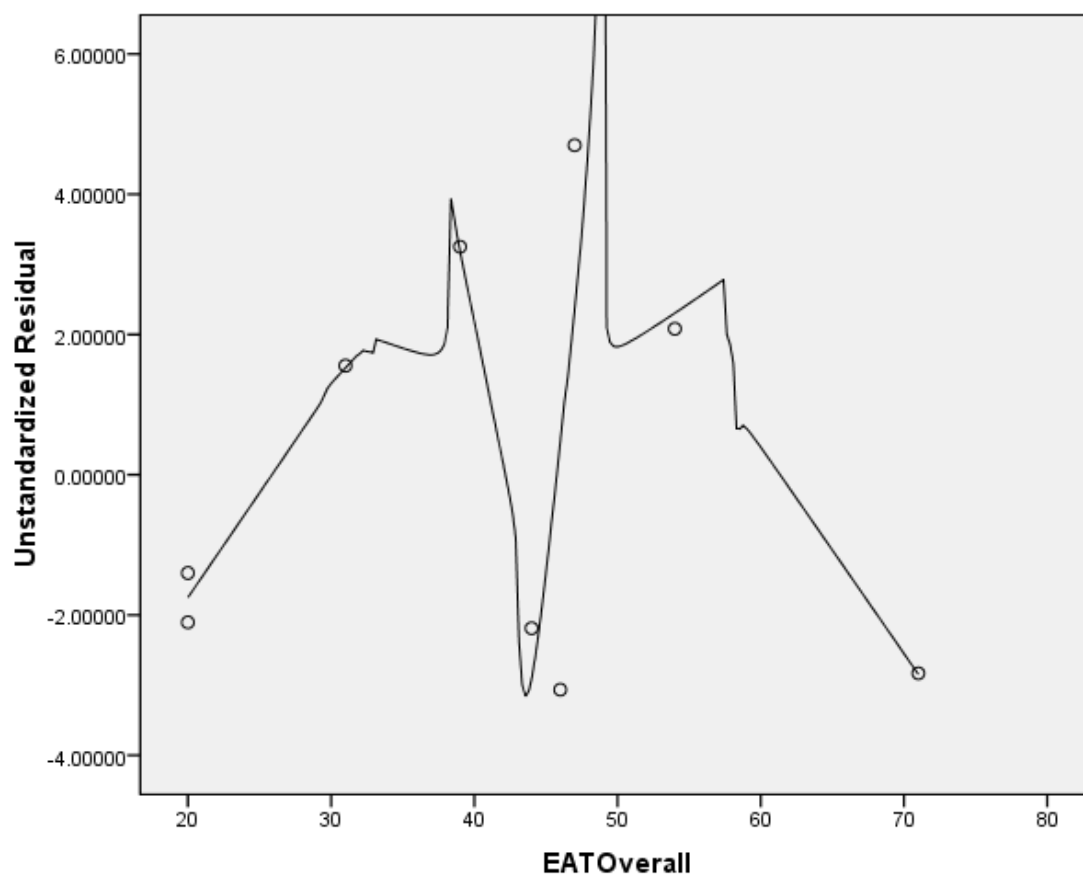


Figure 1. Scatterplot of saved residuals and overall EAT scores from the original regression model testing the assumption of correct model specification.

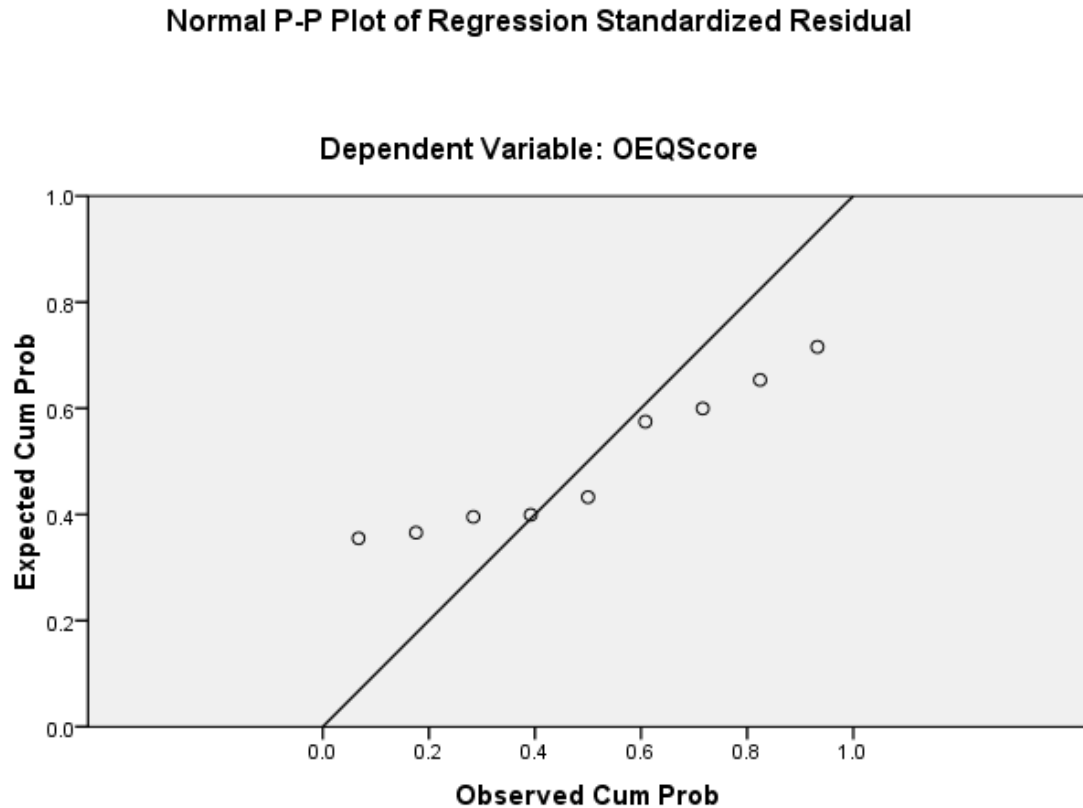


Figure 2. Normal P-P Plot of Regression Standardized Residuals testing the assumption of normality of the residuals.

No other regression assumptions appear to be violated. However, additional concern for the proposed model comes after review of the bivariate correlations calculated for each of the seven predictor variables (Table 1). Based on the very high correlations between each of the individual EAT subscales and the overall EAT score it was deemed appropriate to collapse this particular set of predictors into one variable. For that reason the individual EAT subscales (Dieting, Oral Control, and Bulimia Preoccupation) have been dropped from further analysis and those constructs are represented by the overall EAT score. Despite the similarity between the EAT and the

EDI, they are considered to be conceptually different measures of eating disorder symptomatology and will therefore be analyzed as such.

#### Case Diagnostics

The data were reviewed for unusual scores and outliers. Bivariate scatterplots and frequency distributions revealed one potential multivariate outlier, with an extremely high score on the OEQ and an extremely low score on the EAT. The data were centered and a series of case diagnostic statistical tests to determine the impact of this potential outlier were conducted, including the tests of Leverage and Discrepancy. Both visually and by using the cutoff criteria of  $>3k/N = .55$  for this sample (where  $k$  = number of predictor variables), Leverage scores ruled out this case as a major outlier, with a centered Leverage value of .045. A subsequent calculation of discrepancy scores and review of case by studentized residual scatterplots confirmed the inclusion of this case in the database. Deleted residuals were well below the standard cutoff of 4 for a sample of  $N = 22$ .

#### Sample Characteristics

Descriptive statistics and results for the basic zero-order correlations for the original set of predictor variables can be found in Table 1. Descriptive statistics and results for the basic zero-order correlations for the new set of predictor variables dropping each of the three EAT subscales can be found in Table 2. The following analyses were conducted in accordance with the proposed research design, which included an ideal sample size of  $N \geq 50$ . Despite the final sample size of  $N = 22$ , parametric statistical tests were used, in an effort to demonstrate the appropriate statistical analyses for the original research proposal.

Table 1: Descriptive statistics and basic zero order correlations for the Obligatory Exercise Questionnaire (OEQ), the Eating Attitudes Test-26 (EAT), and the Eating Disorders Inventory-3 (EDI).

	M	SD	1	2	3	4	5	6	7
1. OEQ Total	51.50	14.93							
2. Axis V	62.50	3.54	.23						
3. EAT Overall	27.45	18.03	.67**	.35					
4. EAT Dieting	14.50	10.91	.57**	.38	.92**				
5. EAT Bulimia	5.27	4.12	.61**	.31	.86**	.67**			
6. EAT Oral	6.91	5.00	.61**	.34	.85**	.63**	.72**		
7. EDI DT	12.15	8.71	.61*	.23	.82**	.91**	.59*	.55	
8. EDI BD	15.62	11.69	.45	-.07	.60*	.62*	.52	.34	.73**

Note. N = 22. \*\* indicates  $p < .01$ ; \* indicates  $p < .05$ .

Table 2: Descriptive statistics and basic zero order correlations for the Obligatory Exercise Questionnaire (OEQ), the Eating Attitudes Test-26 (EAT), and the Eating Disorders Inventory-3 (EDI).

	M	SD	1	2	3	4
1. OEQ Total	51.50	14.93				
2. EAT Overall	27.45	18.03	.67**			
3. Axis V	62.50	3.54	.23	.35		
4. EDI Drive Thinness	12.15	8.71	.61*	.82**	.23	
5. EDI Body Diss.	15.62	11.69	.45	.60*	-.07	.73**

Note. N = 22. \*\* indicates  $p < .01$ ; \* indicates  $p < .05$ .

Results of independent samples t tests revealed non-significant differences between males and females on BMI ( $t(20) = 1.73$ ,  $p = .10$ ; two-tailed), Axis V diagnosis ( $t(8) = -.91$ ,  $p = .39$ ; two-tailed), OEQ scores ( $t(20) = .00$ ,  $p = 1.00$ ; two-tailed;  $M = 51.50$  for both groups), Overall EAT scores ( $t(20) = -.82$ ,  $p = .42$ ; two-tailed), EAT Dieting ( $t(20) = -.60$ ,  $p = .56$ ; two-tailed), EAT Oral Control ( $t(20) = -.39$ ,  $p = .70$ ; two-tailed), EAT Bulimia Preoccupation ( $t(20) = -1.24$ ,  $p = .23$ ; two-tailed), EDI Drive for Thinness ( $t(11) = -.02$ ,  $p = .99$ ; two-tailed), and EDI Body Dissatisfaction ( $t(11) = -.85$ ,  $p = .42$ ; two-tailed). A one way analysis of variance (ANOVA) revealed non-significant differences between eating disorder diagnoses (AN, BN, ED-NOS) on Axis V diagnosis ( $F(1,8) = 2.00$ ,  $p = .20$ ), OEQ scores ( $F(2,19) = .29$ ,  $p = .75$ ), Overall EAT scores ( $F(2,19) = .60$ ,  $p = .56$ ), EAT Dieting ( $F(2,19) = 2.15$ ,  $p = .14$ ), EAT Oral Control ( $F(2,19) = .28$ ,  $p = .76$ ), EAT Bulimia Preoccupation ( $F(2,19) = .32$ ,  $p = .73$ ), EDI Drive for Thinness ( $F(2,10) = 1.93$ ,  $p = .20$ ), and EDI Body Dissatisfaction ( $F(2,10) = 1.42$ ,  $p =$

.29). A significant difference was found between groups on BMI ( $F(2,19) = 3.77, p = .04$ ), such that patients diagnosed with BN tended to have the highest BMI ( $M = 19.2$ ;  $SD = .00$ ;  $n = 2$ ), while patients diagnosed with AN tended to have the lowest BMI ( $M = 16.26$ ;  $SD = 1.89$ ;  $n = 11$ ).

#### Comparison of Means on the Predictor Variables Based on Exercise Status

Currently, there is no established clinical cutoff to determine “high” versus “low” exercisers using the OEQ in its original form. To determine exercise status and an appropriate “high” versus “low” exercise cutoff, participants’ OEQ scores were examined for an obvious split in the data. The largest jump in data was observed between scores of 40 and 46, with 7 participants scoring 40 or below (range of 25 to 40) and 15 participants scoring 46 or above (range of 46 to 74). To confirm this cutoff, scores were generated for each of the three dimensions identified in Steffen and Brehm’s (1999) factor analysis of the OEQ: emotional element of exercise, exercise frequency and intensity, and exercise preoccupation. Groups were also compared on total OEQ scores. Results of these mean comparisons revealed significant differences between high and low exercisers on total OEQ scores ( $t(20) = -6.56, p < .001$ ; two-tailed), emotional element of exercise ( $t(20) = -4.09, p = .001$ ; two-tailed), exercise frequency and intensity ( $t(20) = -5.48, p < .001$ ; two-tailed), and exercise preoccupation ( $t(20) = -2.90, p = .01$ ; two-tailed), supporting the proposed cutoff.

Independent samples  $t$  tests were then used to compare participants’ scores on each predictor variable of interest based on their “high” versus “low” exercise status. Results of these univariate analyses revealed a significant difference between low and high exercisers on overall EAT scores ( $t(20) = -2.43, p = .03$ ; two-tailed), such that high

scorers on the EAT tended to also score higher on the OEQ. Differences on EDI drive for thinness and EDI body dissatisfaction were non-significant, although scores were in the hypothesized direction with means of 6.75 (SD = 8.38) and 8.25 (SD = 9.54) for the low exercisers, respectively, and means of 14.56 (SD = 8.14) and 18.89 (SD = 11.47) for the high exercisers, respectively. A mean comparison of Axis V diagnoses revealed identical GAF scores for both the high and low exercise groups.

#### Polynomial Regression

After consideration of the aforementioned assumption violations and the possibility of a misspecified model, a curvilinear relationship between participants' overall EAT and OEQ scores was explored. Quadratic and cubic terms were created for the centered overall EAT score, and OEQ scores were regressed onto each. Results for this analysis can be found in Table 3. The cubic regression term approached significance ( $F(3,18) = 7.66$ ,  $p = .05$ ,  $R = .75$ ,  $R^2 = .56$ , and  $SEE = 10.69$ ; Figure 3), and it was therefore included in the final regression model examining the various psychological and diagnostic predictors of excessive exercise. Unfortunately, the model failed to run, as the quadratic and cubic terms were automatically excluded from the analysis in SPSS, most likely due to the small sample size.



Table 3: Polynomial regression model for the EAT Overall.

	b	S.E.	$\beta$	$R^2$	$\Delta R^2$	F
<hr/> Model 1						
Excessive Exercise				.44**	.44	15.92
(Intercept)	51.50	2.43				
EAT Overall_c	.55**	.14	.67			
<hr/> Model 2						
Excessive Exercise				.46	.01	7.94
(Intercept)	50.21	3.17				
EAT Overall_c	.52**	.15	.62			
EAT Overall_c**2	.004	.01	.12			
<hr/> Model 3						
Excessive Exercise				.56	.11	7.66
(Intercept)	47.60	3.19				
EAT Overall_c	.93**	.25	1.13			
EAT Overall_c**2	.02	.01	.51			
EAT Overall_c**3	.00	.00	-.82			

Note. N = 22. \*\* indicates  $p < .01$ ; \* indicates  $p < .05$ .

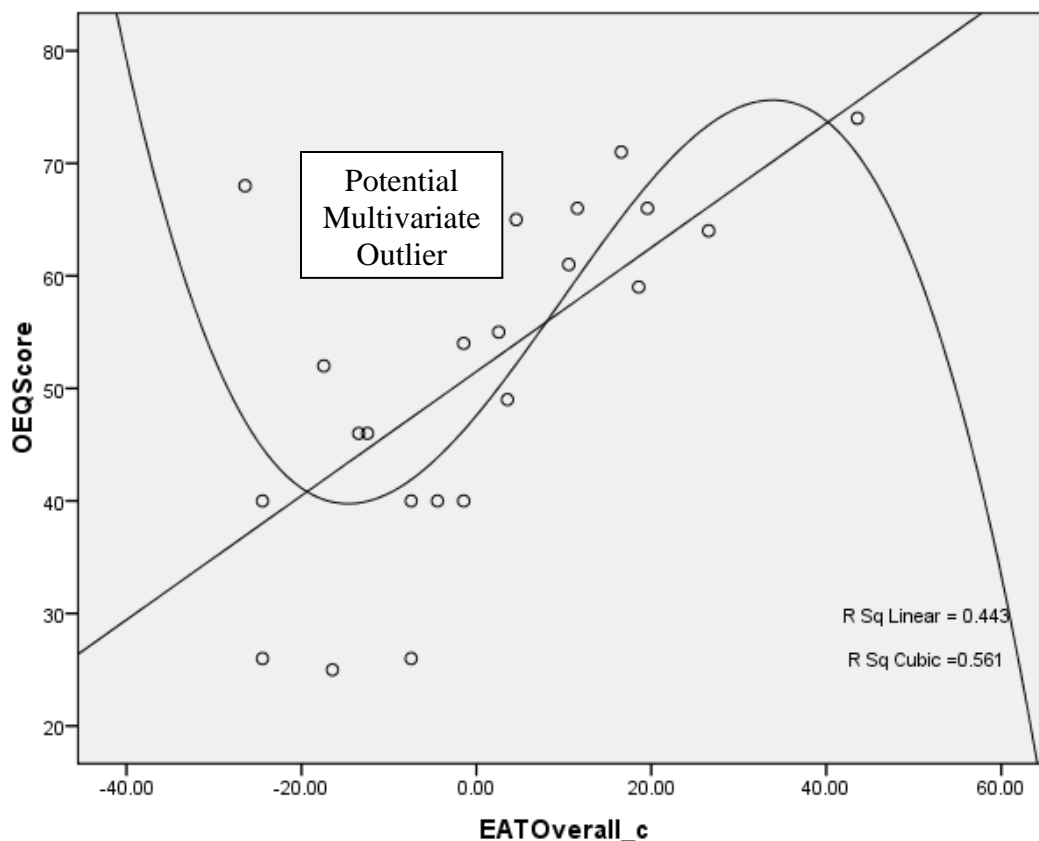


Figure 3. Visual display of the linear and cubic relationships between overall eating disorder attitudes and use of excessive exercise.

### Hierarchical Multiple Regression

The overall multiple regression model, including patients' overall eating attitudes, overall psychopathology, drive for thinness, and body dissatisfaction, was not significant ( $F(1,4) = 42.48$ ,  $p = .12$ ,  $R = .99$ ,  $R^2 = .99$ , and  $SEE = 2.23$ ). Results for the regression analyses can be found in Table 4.

In a manner consistent with the proposed model, though with the updated variable set, the four predictor variables were entered in hierarchical fashion. Patients' overall EAT scores and Axis V scores were entered into the model first. The corresponding  $R^2 =$

.87, indicating that patients' overall eating attitudes and their overall psychological functioning uniquely account for 87% of the total variance in use of excessive exercise as a weight loss or compensatory behavior.

Patients' scores on the drive for thinness and body dissatisfaction subscales of the EDI were entered into the model next. For this last step, the corresponding  $R^2 = .99$ , with  $\Delta R^2 = .12$ , indicating that, combined, these 4 variables account for roughly 99% of the total variance in excessive exercise. Including patients' EDI subscale scores accounted for an additional 12% of the total variance in OEQ scores, though this increase was not significant.

Table 4: Regression model testing for the significance of including drive for thinness and body dissatisfaction in the model.

	b	S.E.	$\beta$	$R^2$	$\Delta R^2$	F
<hr/> Model 1						
Excessive Exercise				.87*	.87	9.79
(Intercept)	77.39	45.13				
EAT Overall	.65*	.16	1.03			
Axis V Diagnosis	-.71	.77	-.23			
<hr/> Model 2						
Excessive Exercise				.99	.12	42.48
(Intercept)	75.61	18.21				
EAT Overall	.11	.15	.18			
Axis V Diagnosis	-.64	.31	-.21			
EDI Drive Thinness	2.56	.58	1.50			
EDI Body Diss.	-.90	.20	-.94			

Note. N = 5. \*\* indicates  $p < .01$ ; \* indicates  $p < .05$ ; b = unstandardized beta weight;  $\beta$  = standardized beta weight.

## CHAPTER 4: DISCUSSION

This study sought to examine the ability of several psychological and diagnostic indicators to predict the use of excessive exercise as a weight loss or compensatory behavior for patients with symptoms of AN or BN in an adolescent community outpatient sample. It was hypothesized that adolescent patients who engage in excessive exercise would report significantly poorer eating attitudes, overall eating disorder symptomatology, and overall psychological status than patients who did not report engaging in excessive exercise. It was also hypothesized that the additional assessment of eating attitudes, preoccupation with dieting and oral control, bulimia and food preoccupation, body dissatisfaction, and drive for thinness would enhance the predictability of excessive exercise use. Available data at the time of analysis included patients' eating disorder diagnoses, overall eating attitudes, overall psychological functioning, drive for thinness, and body dissatisfaction.

Following this study, the nature of the relationship between young patients' psychological functioning, eating disorder symptomatology, and use of excessive exercise remains unclear. A comparison of high versus low exercisers' scores on overall eating attitudes and specific eating disorder symptoms including drive for thinness and body dissatisfaction support previous research findings that high or excessive exercisers, on average, demonstrate poorer functioning in each of these domains, with mean

differences on overall eating attitudes reaching statistical significance in the current sample. These findings are in support of previous research and self-regulation theory, which suggests that eating disorder patients who engage in excessive exercise do so as a way to manage negative mood and some of the more common symptoms and psychological disorders associated with the eating disorders. It is therefore not surprising that patients who adopt this type of pathological self-regulatory behavior would demonstrate more severe eating disorder presentations. However, this study failed to demonstrate that inclusion of additional assessments related to a preoccupation with dieting and oral control, bulimia preoccupation, drive for thinness, body dissatisfaction, and overall psychological functioning enhance the predictability of excessive exercise among adolescent eating disorder outpatients.

There are several possible explanations for the null findings regarding the study's primary hypothesis. First, it is possible that the primary constructs – eating attitudes, overall eating disorder symptomatology, and overall psychological status – are not consistently good predictors of excessive exercise use within the eating disorder population, as other researchers' findings have suggested. However, with a final model that accounted for 99% of the variance in excessive exercise use, this explanation seems unlikely. Alternatively, it is plausible that the primary constructs of interest are actually good predictors of excessive exercise use, but that the current study simply did not achieve sufficient statistical power to detect the proposed effect, owing to the small sample size. A third possible explanation is that overall performance on the EAT (the only variable to achieve statistical significance as a predictor) alone is a sufficient screening tool by itself, such that additional subscale calculations and administration of

supplemental eating disorder assessment tools are unnecessary when determining the presence of excessive exercise. This would ultimately suggest that clinicians could rely on the EAT as a prescreen to excessive exercise, such that only when respondents score high on the EAT (e.g., above 20, the clinical cutoff), should they then be given the OEQ to screen further for exercise attitudes and behavior. Finally, and after consideration of the potential violations of assumptions discussed previously, the null findings of the present study bring into question the possibility of an excluded variable, such as the diagnosis of an additional Axis I disorder (e.g., anxiety and mood disorders), which was included in the set of predictors originally proposed. Other examples include the many additional psychosocial constructs that have been associated with excessive exercise use in eating disorder samples, including patients' negative affect, quality of life, irritability and self-esteem.

### Strengths

This study was designed to address certain limitations within the current eating disorder literature with respect to research examining the use of excessive exercise as a weight loss or compensatory behavior in adolescent outpatients. Limitations of previous work include the use of homogenous convenience samples with respect to age, gender, and racial background; the inclusion of both active and recovered patients; a reliance on retrospective reporting of symptoms and behaviors; and a relatively narrow assessment of excessive exercise (Shroff et al., 2006). While only one non-Caucasian participant was recruited for this study, both the gender and age representation of the current sample are considered strengths. It is estimated that the prevalence rates for AN and BN in men is .3% and .5%, respectively, compared to .9% and 1.5% in women (Hudson et al., 2007). It

is therefore believed that the recruitment of four male participants (18% of the total sample), in this small sample, is overly representative of male eating disorder patients seeking treatment in an outpatient community clinic. Similarly, the ability of this study to recruit patients between the ages of 12 and 19 enhances the external validity of any research findings since this represents a fairly wide range of both physical and cognitive (maturational) development.

An additional strength of this study is the inclusion of a psychometrically sound and thorough assessment of exercise attitudes and behaviors. When investigating the role of excessive exercise in eating disorder expression, many studies have relied solely on one or two questions related to exercise attitudes and/or frequency (Brewerton et al., 1995; Penas-Lledo et al., 2002). Other studies have included alternative measures of excessive or compulsive exercise, including the Commitment to Exercise Scale (Davis, Brewer, & Ratusny, 1993) and the Exercise Dependence Questionnaire (Ogden, Veale, & Summers, 1997); however, these measures were considered psychometrically weak and inappropriate for use with eating disorder patients in comparison to the OEQ.

### Limitations

The most notable limitations of the current study relate to the small sample size and the difficulty of working with psychological patients seeking treatment within a medical setting. It is believed that these limitations impede the researcher's ability to extrapolate beyond the current sample to the larger adolescent eating disorder population. The small sample size arguably contributed to an inability to thoroughly investigate a possible non-linear relationship between the predictor variables and excessive exercise. A curvilinear relationship was examined between each of the primary independent and



dependent variables after assumption violations were discovered. In effort to make sense of the possibility of an incorrectly specified model, polynomial terms were created for patients' overall EAT scores, Axis 5 diagnoses, EDI drive for thinness scores and EDI body dissatisfaction scores. None of the polynomial terms was found to be significant when entered into the regression model alone with OEQ scores; however, the cubic term for patients' overall EAT scores approached significance. Unfortunately, a final model including the quadratic and cubic terms for overall EAT scores could not be analyzed. Possible implications of failing to confirm the shape of the model include calling into question the accuracy of the study predictions and an inability to generalize any study findings beyond the sample in question. It should be noted that assumption violations are often sample specific, and when evident, they should be cross-validated. It is assumed that a larger sample size would allow for a better understanding of the (potential) non-linear relationship between patients' overall eating attitudes and (the ability to predict use of) excessive exercise as either a weight loss or compensatory behavior.

When conducting research with this population, it is important to remember that the overall base rate for eating disorders in general is low compared to other psychological diagnoses. Several studies with samples comprised of clinical eating disorder patients that did not rely solely on archival data (i.e., medical records) have reported sample sizes similar to that of the current study. For example, Ruuska and colleagues (2005) collected data from adolescents seeking treatment at outpatient eating disorder clinics for 2 years and 7 months and recruited just 57 participants. Similarly, Eddy and colleagues (2008) collected data from adolescents at an outpatient eating disorder clinic for 5 years and 4 months and recruited just 281 participants. With a

slightly better recruitment rate, Finzi-Dottan and Zubery (2009) collected data at an outpatient eating disorder clinic for 2 years for a total sample size of 169 participants.

A second limitation directly related to the small sample size is the study's forced reliance on retrospective data related to eating attitudes and behaviors for most ( $n = 14$  or 64%) participants. Initially, only new patients to the CDE were invited to participate in the study; however, in order to increase the rate of study recruitment, it was eventually decided that all active patients of the clinic would be invited to participate, regardless of how much time they had already spent in treatment. As a result, only eight participants (36%) were able to complete the OEQ within their first two months of treatment. All other participants were asked to complete the measure as they would have responded at the start of treatment. For those participants answering retrospectively, the range of time spent in treatment at the time of recruitment was between 7 and 35 months.

A third limitation was the lack of racial diversity in the sample. Recent estimates of 12-month prevalence rates for AN and BN in adolescent African and Caribbean (Black) Americans is 0% and 0.43% for females, and 0.15% and 0.37% for males, respectively (Taylor, Caldwell, Baser, Faison, & Jackson, 2007). Given that the general estimates of prevalence for all adolescent eating disorders are between 0.04% and 3.0% in girls and between 0 and 0.2% of boys (Hudson et al., 2007), the recruitment of one black male with a diagnosis of AN into the current study is considered fortunate. Again, with a larger sample size a more racially diverse and representative sample would be anticipated.

As noted, additional limitations relate to the difficulty of conducting research with psychological patients seeking treatment within a medical setting. The introduction of

clinical psychology into the medical setting is not a new practice, and is, in fact, increasingly promoted as a key component to the advancement of more efficient and holistic approaches to healthcare. However, despite growing agreement among healthcare professionals about the value of including psychological services in patient care, when budgets are cut, mental health services are often the first to be scaled back. The original research proposal contemplated an investigation of patients' full Axis I diagnoses, including the primary eating disorder diagnosis and any Axis I comorbidities, as well as a precise Axis V diagnosis (global assessment of functioning, or GAF score) as possible predictors of excessive exercise use. Unfortunately, it was not possible to obtain a thorough and complete multi-axial diagnosis for each participant since no diagnostic information was available related to possible comorbid Axis I disorders, and the GAF scores provided for patients' Axis V diagnoses are considered imprecise. For example, the only GAF scores given were 60 (n=6), 65 (n=3) and 70 (n=1), and this information was missing for 55% (n=12) of the sample. Failure to acquire this information is believed to be a direct result of the CDE's loss of its clinical psychologist just after data collection began due to a loss of funding.

An additional limitation to this study was the severe multicollinearity between the individual and overall EAT subscale scores, which resulted in a loss of the individual subscales representing the dimensions of dieting, bulimia and food preoccupation, and oral control. The collapse of four variables into one arguably yielded more statistical power, particularly in light of the present study's small sample size. Unfortunately this came at the expense of the study's primary objective, which was to determine the predictive ability of the most commonly addressed psychological and diagnostic

constructs on excessive exercise use, and ultimately to enhance treatment standards. Furthermore, a loss of the EAT subscales diminished the ability of this study to examine individual eating disorder experiences thoroughly at a micro level, because patients could obtain identical overall scores by answering individual items differently (Williams, 1987).

In a similar vein, the high correlations between the EDI subscales of drive for thinness and body dissatisfaction and the overall EAT score ( $\alpha = .82$  and  $\alpha = .60$ , respectively) indicate a comparable level of multicollinearity. Despite the similarity between the EAT and the EDI, they are considered to be conceptually different measures of eating disorder symptomatology and were therefore analyzed as such. For example, the EDI was originally created to distinguish more precisely between the behaviors and cognitions associated with true eating disorder related pathology as opposed to those associated with subclinical presentations of the illnesses (i.e., “extreme dieters”; Williams, 1987). In a study comparing the EDI and the EAT in a sample of late adolescent to adult female psychiatric inpatients, Cooper and colleagues (1985) found relationships between the two measures similar to those found in the current study, including significant correlations between the overall EAT score and the EDI subscales of drive for thinness, body dissatisfaction, and bulimia. Because the constructs of drive for thinness and body dissatisfaction are two of the more clinically relevant constructs, a logical conclusion for clinicians might be to rely solely on the EAT as the most efficient screening tool for an eating disorder diagnosis given the high correlations between these two subscales and the overall EAT score, and the preferred (shorter) length of the EAT to the EDI (26 items versus 91 items, respectively). However, because of the rarity of the

eating disorders in general and the positive predictive value of 19% for the EAT and AN (i.e., for every 100 high scores on the EAT, only 19 will yield an actual AN diagnosis), clinicians are cautioned against relying solely on one measure as a diagnostic tool (Cooper et al., 1985; Williams, Hand, & Tarnopolsky, 1982). Alternatively, if the clinical question is specifically related to the presence of excessive exercise as a contributory factor to an individual patient's eating disorder diagnosis and/or treatment experience, reliance on the OEQ would be appropriate, as it was found to be significantly correlated with the overall EAT score and the EDI drive for thinness score. The OEQ was only modestly correlated with the EDI body dissatisfaction score.

#### Future Research

The results of this study highlight the need for additional research examining the clinical nature of excessive exercise use as a weight loss or compensatory behavior in adolescent eating disorder patients with symptoms of AN or BN. A future study examining the role of excessive exercise within the disordered eating population through the framework of self-regulation theory should consider actually measuring patients' self-regulation practices as a way to test whether or not the appropriate theoretical framework has been applied. Being able to compare exercise attitudes and behaviors between patients who report practicing self-regulation techniques and those who do not could help to further differentiate the extent of pathology within those patients who score high on the OEQ. For example, Kitsantas and colleagues (2003) collected self-regulatory data from participants with and without eating disorders and found that higher numbers of specific self-regulatory behaviors were predictive of higher levels of eating disorder related pathology in general. Examples of self-regulatory behaviors relevant to the eating

disorders include goal setting and goal planning, environmental structuring, self-evaluation, information and social assistance seeking, self-monitoring, and self-consequating. It is believed that questions targeting each of these individual practices could be phrased in such a way as to address patients' exercise attitudes and behaviors specifically. A subsequent analysis to determine which self-regulatory practices are most predictive of excessive exercise use could facilitate the screening process and ultimately help determine treatment goals.

Future studies should strive for longer-term data collection in order to ensure an adequate sample size to test, with greater confidence, the primary hypotheses. An emphasis on the recruitment of ethnic minorities and subsequent comparisons between ethnic groups on the prevalence of excessive exercise use among adolescent or adult samples and the differences and/or similarities of symptom expression would also be beneficial. With regard to the expression of excessive exercise in multiple populations, future studies should consider combining the two common threads of questioning, including gathering information related to the frequency, intensity, and duration of typical exercise sessions in eating disorder patients, as well as questions that capture the emotional and motivational elements behind exercise (e.g., the OEQ). By paying particular attention to any commonalities or differences between groups, these efforts would potentially enhance the external validity of the studies' findings.

It is hoped that a future study will be able to explore fully the potential non-linear relationship between patients' overall eating attitudes (overall EAT scores) and their tendency to engage in excessive exercise for weight loss or compensatory reasons (OEQ scores). In the present study, the overall EAT score was the only variable able to predict

OEQ scores when testing a linear relationship between the predictor variables and excessive exercise. The subsequent discovery of a cubic trend for EAT scores is surprising given what is known about the relationship between excessive exercise use in eating disorder patients and their overall symptomatology. Specifically, it has been demonstrated that patients diagnosed with eating disorders who endorse engaging in excessive exercise tend to report more severe symptoms overall, including early symptom expression, poorer treatment outcomes, a shorter time to relapse, and a lower current and lifetime BMI (Brewerton et al., 1995; Strober et al., 1997; Shroff et al., 2006). Moreover, they are at heightened risk for amenorrhea and significantly longer inpatient hospital stays (Fisher et al., 1995; Solenberger, 2001). In other words, it is a linear relationship between excessive exercise and overall eating disorder experience that has thus far been demonstrated. If revealed, a significant cubic relationship (with a positive beta weight) could indicate that on the continuum of eating disorder symptomatology, there are two possible ranges of symptom experience that might be associated with an increase in use of excessive exercise (see Figure 3). However, because there is no established cutoff to determine the clinical significance of excessive exercise use based on the OEQ, it is possible that an increase of scores on the OEQ early in the eating disorder continuum actually represents subclinical uses of exercise, while the rise in scores associated with more severe symptom expression is the only truly relevant exercise behavior for treatment purposes.

It should be reiterated that a significant cubic relationship between patients' excessive exercise use and overall eating disorder symptomatology could not be tested here (most likely due to the small sample size), although the ability of the cubic aspect of

overall eating disorder experience to predict use of excessive exercise approached significance. A second (and more probable) explanation for the cubic trend could involve the individual outlier discussed previously (and as indicated in Figure 3). It is well known that polynomial equations are highly sensitive to extreme data points. Despite the fact that visual inspection of the data raised suspicion, results of a series of diagnostic tests failed to reveal any statistical reason to drop the participant from the data set. Additional evidence of the likely tenuous relationship between the cubic aspect of patients' overall eating attitudes and excessive exercise use is the value of the overall EAT beta weight (0.00) and the 0.00 confidence interval (CI = -.001 and .000). Nonetheless, in light of the findings of the current study, additional exploration into the potential curvilinear nature of this relationship (with a larger sample to allow for a more stable regression equation) is warranted.

In the interest of enhancing current standards of treatment for eating disorder patients who endorse engaging in excessive exercise, additional work to determine a clinically useful cutoff score on the OEQ is also needed. Ackard and colleagues (2002) have taken an initial step in this process by identifying a six-tiered classification scheme of exercise status based on a factor analysis of the OEQ and respondents' performance on the EDI and several other psychosocial measures. Of the six resulting exercise profiles, two included patients who endorsed frequently engaging in exercise. One group included exercisers who also endorsed high levels of exercise fixation, including the use of exercise as a compensatory behavior and negative emotionality resulting from missed exercise sessions. The second group reported high levels of exercise engagement, though without the accompanying negative emotionality. Not surprisingly, participants in the



former group also tended to score higher on all EDI subscales (including drive for thinness and body dissatisfaction) compared to those in the latter group. It should be noted that participants in this study were female college undergraduates and did not comprise a clinical sample. A follow-up study to determine similar profiles using the overall OEQ score and a clinical sample could potentially offer a more efficient way of identifying patients in need of addressing their exercise attitudes and behaviors in treatment.

### Conclusion

Overall, this study highlights the challenges associated with conducting research within medical institutions that serve psychological patients seeking treatment for relatively rare diagnostic disorders. To the author's knowledge, it is the first study to attempt to examine the various psychological and diagnostic predictors of excessive exercise use in an adolescent outpatient sample. Clinical protocols that directly target exercise attitudes and behaviors within eating disorder treatment programs have advanced in the past decade, most recently with controversial guidelines that include the use of exercise as a treatment tool (Calogero & Pedrotty, 2004). The current study was designed with the interests of clinicians in mind, and the goal of enhancing current treatment standards. It is hoped that follow-up studies aimed at examining the role of excessive exercise use within the clinical, treatment-seeking population will further take care to design protocols that (1) allow for longer-term data collection periods and (2) can secure the diagnostic services of a clinical psychologist.

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## APPENDIX A: PARENT/YOUTH REFUSAL TO PARTICIPATE FORM

Individual *refusing* to participate:                  youth                  parent                  NA

Individual who is *ineligible* to participate:   youth                  parent                  NA

Patient's age: \_\_\_\_\_

Patient's sex:   Male   Female

Patient's race: \_\_\_\_\_

Reason for refusal:

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## APPENDIX B: DEMOGRAPHICS FORM: PATIENTS

1. How old are you today? \_\_\_\_\_ 2. What is your date of birth? \_\_\_\_\_

3. What is your sex? (please check only one): \_\_\_\_\_ female \_\_\_\_\_ male

4. What is your race? (please check only one):

- |  |   |
|--|---|
| <input type="checkbox"/> _____ Caucasian (white) | <input type="checkbox"/> _____ African American |
| <input type="checkbox"/> _____ Hispanic          | <input type="checkbox"/> _____ Asian            |
| <input type="checkbox"/> _____ Native American   | <input type="checkbox"/> _____ Middle Eastern   |
| <input type="checkbox"/> _____ Multi-racial      | (e.g., Persian, Saudi Arabian                   |
| <input type="checkbox"/> _____ Other             | Iranian, Iraqi)                                 |

5. In what grade are you currently? (please check only one):

- |                       |                        |
|-----------------------|------------------------|
| _____ 5 <sup>th</sup> | _____ 9 <sup>th</sup>  |
| _____ 6 <sup>th</sup> | _____ 10 <sup>th</sup> |
| _____ 7 <sup>th</sup> | _____ 11 <sup>th</sup> |
| _____ 8 <sup>th</sup> | _____ 12 <sup>th</sup> |

\_\_\_\_\_ I dropped out of school during my \_\_\_\_\_ year.

\_\_\_\_\_ I graduated from high school and am currently not attending college.

\_\_\_\_\_ Freshman year of college.

\_\_\_\_\_ Sophomore year of college.

\_\_\_\_\_ Junior year of college.

\_\_\_\_\_ Senior year of college.



## DEMOGRAPHICS FORM: PARENTS

1. How old are you today? \_\_\_\_\_ 2. What is your date of birth? \_\_\_\_\_

3. What is your sex? (please check only one): \_\_\_\_\_ female \_\_\_\_\_ male

4. What is your relation to the patient?  
\_\_\_\_\_

5. What is your race? (please check only one):

- |  |   |
|--|---|
| <input type="checkbox"/> _____ Caucasian (white) | <input type="checkbox"/> _____ African American |
| <input type="checkbox"/> _____ Hispanic          | <input type="checkbox"/> _____ Asian            |
| <input type="checkbox"/> _____ Native American   | <input type="checkbox"/> _____ Middle Eastern   |
| <input type="checkbox"/> _____ Multi-racial      | (e.g., Persian, Saudi Arabian                   |
| <input type="checkbox"/> _____ Other             | Iranian, Iraqi)                                 |

6. What is your current relationship status? (please check only one):

- ☐ \_\_\_\_\_ Single
- ☐ \_\_\_\_\_ Divorced
- ☐ \_\_\_\_\_ Separated
- ☐ \_\_\_\_\_ Married
- ☐ \_\_\_\_\_ Committed partnership

7. What is the highest degree or level of school you have completed? (please check only one):

- ☐ \_\_\_\_\_ Some high school but no degree
- ☐ \_\_\_\_\_ High school graduate, high school diploma, or GED
- ☐ \_\_\_\_\_ Some college but no degree
- ☐ \_\_\_\_\_ College degree
- ☐ \_\_\_\_\_ Graduate education

8. What is your current employment status? (please check only one):

- ☐ \_\_\_\_\_ Currently not working
- ☐ \_\_\_\_\_ Currently working part time:  
Please indicate how many hours you work per week:  
\_\_\_\_\_
- ☐ \_\_\_\_\_ Currently working full time:  
Please indicate how many hours you work per week:  
\_\_\_\_\_
- ☐ \_\_\_\_\_ Out of the labor market

9. What is your total household income?

- ☐ \_\_\_\_\_ Less than \$9,999
- ☐ \_\_\_\_\_ \$10,000 to \$19,999
- ☐ \_\_\_\_\_ \$20,000 to \$29,999
- ☐ \_\_\_\_\_ \$30,000 to \$39,999
- ☐ \_\_\_\_\_ \$40,000 to \$49,999
- ☐ \_\_\_\_\_ \$50,000 to \$59,999
- ☐ \_\_\_\_\_ \$60,000 to \$69,999
- ☐ \_\_\_\_\_ \$70,000 to \$79,999
- ☐ \_\_\_\_\_ \$80,000 to \$89,999
- ☐ \_\_\_\_\_ \$90,000 to \$99,999
- ☐ \_\_\_\_\_ More than \$100,000

10. Has anyone else in your family ever been diagnosed with an eating disorder? If yes, please explain.

\_\_\_\_\_ Yes

\_\_\_\_\_ No

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## APPENDIX C: THE OBLIGATORY EXERCISE QUESTIONNAIRE

By Pasman, L. &amp; Thompson, J. K.

*Directions:*

Listed below are a series of statements about people's exercise habits. Please circle the number that reflects how often you could make the following statements:

	1 – NEVER	2 – SOMETIMES	3 – USUALLY	4 – ALWAYS
1. I engage in physical exercise on a daily basis.	1	2	3	4
2. I engage in one/more of the following forms of exercise: walking, jogging/running or weightlifting	1	2	3	4
3. I exercise more than three days per week.	1	2	3	4
4. When I don't exercise I feel guilty.	1	2	3	4
5. I sometimes feel like I don't want to exercise, but I go ahead and push myself anyway.	1	2	3	4
6. My best friend likes to exercise.	1	2	3	4
7. When I miss an exercise session, I feel concerned about my body possibly getting out of shape.	1	2	3	4
8. If I have planned to exercise at a particular time and something unexpected comes up (like an old friend comes to visit or I have some work to do that needs immediate attention) I will usually skip my exercise for that day.	1	2	3	4
9. If I miss a planned workout, I attempt to make up for it the next day.	1	2	3	4
10. I may miss a day of exercise for no good reason.	1	2	3	4
11. Sometimes, I feel a need to exercise twice in one day, even though I may feel a little tired.	1	2	3	4

	1 – NEVER	2 – SOMETIMES	3 – USUALLY	4 – ALWAYS
12.	If I feel I have overeaten, I will try to make up for it by increasing the amount I exercise.			1   2   3   4
13.	When I miss a scheduled exercise session I may feel tense, irritable or depressed.			1   2   3   4
14.	Sometimes, I find that my mind wanders to thoughts about exercising.			1   2   3   4
15.	I have had daydreams about exercising.			1   2   3   4
16.	I keep a record of my exercise performance, such as how long I work out, how far or fast I run.			1   2   3   4
17.	I have experienced a feeling of euphoria or a high during or after an exercise session.			1   2   3   4
18.	I frequently push myself to the limits.			1   2   3   4
19.	I have exercised when advised against such activity (i.e. by a doctor, friend, etc.).			1   2   3   4
20.	I will engage in other forms of exercise if I am unable to engage in my usual form of exercise.			1   2   3   4

## APPENDIX D: THE EATING ATTITUDES TEST-26

Instructions: Please place an X under the word which best applies to the statements below.

		Always	Very Often	Often	Sometimes	Rarely	Never
1.	I am terrified about being overweight.						
2.	I avoid eating when I am hungry.						
3.	I find myself preoccupied with food.						
4.	I have gone on eating binges where I feel that I may not be able to stop.						
5.	I cut my food into small pieces.						
6.	I am aware of the calorie content of foods that I eat.						
7.	I particularly avoid food with a high carbohydrate content (i.e., bread, rice, potatoes, etc.)						
8.	I feel that others would prefer if I ate more.						
9.	I vomit after I have eaten.						
10.	I feel extremely guilty after eating.						
11.	I am preoccupied with a desire to be thinner.						
12.	I think about burning up calories when I exercise.						
13.	Other people think that I am too thin.						
14.	I am preoccupied with the thought of having fat on my body.						
15.	I take longer than others to eat my meals.						
16.	I avoid foods with sugar in them.						
17.	I eat diet foods.						
18.	I feel that food controls my life.						

19.	I display self-control around food.						
20.	I feel that others pressure me to eat.						
21.	I give too much time and thought to food.						
22.	I feel uncomfortable after eating sweets.						
23.	I engage in dieting behavior.						
24.	I like my stomach to be empty.						
25.	I enjoy trying new rich foods.						
26.	I have the impulse to vomit after meals.						